

CLAIMS:

1. An electrochemical cell comprising a cathode, an anode and an electrolyte, wherein:

the cathode comprises mesoporous nickel having a periodic arrangement of substantially uniformly sized pores of cross-section of the order of 10^{-8} to 10^{-9} m; and the anode comprises a mesoporous material having a periodic arrangement of substantially uniformly sized pores of cross-section of the order of 10^{-8} to 10^{-9} m and selected from: carbon, cadmium, iron, a palladium/nickel alloy, an iron/titanium alloy, palladium or a mixed metal hydride.

2. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the cathode comprises nickel and an oxide, hydroxide or oxy-hydroxide of nickel selected from NiO, Ni(OH)₂ and NiOOH, said nickel oxide, hydroxide or oxy-hydroxide forming a surface layer over said nickel and extending over at least the pore surfaces.

3. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the cathode comprises a metal selected from: nickel; alloys of nickel, including nickel alloys with a transition metal, nickel/cobalt alloys and iron/nickel alloys.

4. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a pore diameter within the range from 1 to 10 nm, preferably from 2.0 to 8.0 nm.

5. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a pore number density of from 4×10^{11} to 3×10^{13} pores per cm², preferably from 1×10^{12} to 1×10^{13} pores per cm².

6. An electrochemical cell according to any preceding claim, wherein at least 85 % of the pores in the mesoporous structure have pore diameters to within 30 %, preferably within 10 %, more preferably within 5 %, of the average pore diameter.

7. An electrochemical cell according to any preceding claim, wherein the mesoporous structure has a hexagonal arrangement of pores that are continuous through the thickness of the electrode.
8. An electrochemical cell according to claim 7, wherein the hexagonal arrangement of pores has a pore periodicity of in the range from 5 to 9 nm.
9. An electrochemical cell according to any preceding claim, wherein the mesoporous structure is a film having a thickness in the range from 0.5 to 5 micrometers.
10. An electrochemical cell according to any preceding claim, wherein the negative electrode comprises a material selected from carbon and palladium.
11. An electrochemical cell according to any preceding claim, wherein the mesoporous structure of the positive electrode comprises nickel and an oxide, hydroxide or oxy-hydroxide of nickel selected from NiO, Ni(OH)₂ and NiOOH, said nickel oxide, hydroxide or oxy-hydroxide forming a surface layer over said nickel and extending over at least the pore surfaces, and the negative electrode has a mesoporous structure of carbon or palladium.